Evaluation of Bacteriological Profile in Active Mucosal Chronic Otitis Media - A Cross-Sectional Study

Smitha B.[1], Swapna U.P.[2], Salilkumar K.[3]

[1, 2, 3] Department of ENT, SUT Academy of Medical Sciences, Trivandrum, Kerala, India.

ABSTRACT

BACKGROUND

Active mucosal chronic otitis media (COM) is a disease of the middle ear cleft associated with inflammation and production of pus. The incidence is high in developing countries. It affects all age groups and both genders. If not properly treated, it can lead to complications. The bacterial isolates and their sensitivity pattern vary from place to place and also over time. Early identification of the microorganisms and their antibiotic sensitivity patterns helps in proper selection of antibiotics and quick recovery in COM patients.

METHODS

Fifty patients with active mucosal COM were selected for the study. The study was conducted over a period of one year. Ear swab from the deep external auditory canal was collected under strict aseptic precautions from these patients before starting antibiotic treatment. Microorganisms were identified by gram staining, growth on different agar plates, and various biochemical tests. Antibiotic sensitivity was done by the Kirby-Bauer method.

RESULTS

Majority of the patients were in the age group of 21 - 40 years (42 %) with female preponderance (62 %). All patients had a central perforation in the tympanic membrane (100 %). Bacterial growth was seen in 44 samples (88 %). Two samples (4 %) showed fungal growth. Four samples (8 %) showed no growth even after 48 hours of incubation. Single bacterium was isolated in 41 cases (82 %) whereas 3 samples (6 %) showed more than one bacterial growth. The predominant bacteria were *Pseudomonas aeruginosa* (50 %) followed by *Staphylococcus aureus*. The other isolates were coagulase negative staphylococci, enterococci, enterobacter, acinetobacter, and *E coli*. Pseudomonas showed maximum sensitivity to amikacin, imipenem and piperacillin / tazobactam (100 %). The most effective antibiotics for staphylococcus was vancomycin and linezolid.

CONCLUSIONS

The most common bacteria isolated in active mucosal COM were pseudomonas followed by *Staphylococcus aureus*. The most effective antibiotics for pseudomonas was amikacin, imipenem and piperacillin / tazobactam. Staphylococcus showed maximum sensitivity to vancomycin and linezolid.

KEYWORDS

Chronic Otitis Media (COM), Active Mucosal, Ear Swab, Bacteriology, Sensitivity

Corresponding Author:
Dr. Swapna U.P.,
Associate Professor,
Department of ENT,
SUT Academy of Medical Sciences,
Vattappara – 695028, Trivandrrum,
Kerala, India.
E-mail: swapnamanoj@gmail.com

DOI: 10.18410/jebmh/2021/16

How to Cite This Article:
Smitha B, Swapna UP, Salilkumar K. Evaluation of bacteriological profile in active mucosal chronic otitis media - a cross-sectional study. J Evid Based Med Healthc 2021;8(02):80-84. DOI: 10.18410/jebmh/2021/16

Submission 24-09-2020,
Peer Review 30-09-2020,
Acceptance 23-11-2020,
Published 11-01-2021.

BACKGROUND

Chronic otitis media (COM) is a permanent abnormality of pars tensa or pars flaccida of tympanic membrane due to earlier acute otitis media, negative middle ear pressure or otitis media with effusion.[1] COM equates the word Chronic suppurative otitis media (CSOM) used in some other research articles. The pathological subtypes of COM include inactive mucosal disease, active mucosal disease, inactive squamous epithelial disease, active squamous epithelial disease and healed otitis media. Many changes occur in the middle ear and mastoid in patients with COM due to infection and inflammatory reaction. In inactive mucosal COM, there is a permanent perforation of tympanic membrane without ear discharge. Active mucosal COM is a disease of the middle ear cleft associated with inflammation and formation of mucopurulent discharge which comes out through the perforation in the pars tensa of tympanic membrane. Inactive squamous epithelial COM is associated with retraction of tympanic membrane, retraction pocket or tympanic membrane atelectasis. Active squamous epithelial COM is associated with cholesteatoma. In this type the ear discharge is usually foul-smelling and may be blood stained. The foul-smelling discharge is due to osteitis. Cholesteatoma has bone eroding property and hence the chances of complications are more.[1] COM affects all age groups and both sexes.

The prevalence is more in developing countries as compared to developed countries. The chance of infection is more in areas which are overcrowded, and more in individuals with malnutrition and recurrent upper respiratory infections. The incidence is more in individuals with eustachian tube dysfunction, craniofacial abnormalities and immune deficiency. The infection reaches the middle ear either through the eustachian tube or through a pre-existing tympanic membrane perforation. It produces recurrent ear discharge. If not treated properly, it can lead to intratemporal and intracranial complications. The complications are mastoiditis, labyrinthitis, facial palsy, petrositis, meningitis, extradural abscess, subdural abscess, brain abscess, and otitic hydrocephalus. Hence, it is necessary to treat COM as early as possible to prevent complications. Both aerobic and anaerobic organisms are isolated from ear discharge. The common aerobes include *Pseudomonas aeruginosa*, proteus, *Staphylococcus aureus*, coagulase negative staphylococci and *Coliform bacilli*.[1] Anaerobes include bacteroides species and peptostreptococcus species.[2] The bacterial isolates and their antibiotic sensitivity pattern in COM vary from place to place and over time.[2,3,4] Since there is recurrent discharge from the ear, patients use antibiotics frequently. The widespread irrational use of systemic and topical antibiotics leads to multidrug resistant strains. Inadequate and inappropriate use of antibiotics can also lead to complications of COM. Therefore, it is important to identify the bacterial flora and their antibiotic sensitivity at the earliest in these patients.

We wanted to isolate the pathogenic organisms in patients with active mucosal COM and study their antibiotic sensitivity pattern.

METHODS

The study was conducted in the Department of ENT, SUT Academy of Medical Sciences, Trivandrum, Kerala, India, over a period of one year. It was a cross-sectional study approved by the institutional ethical committee. Fifty patients with active mucosal COM who fulfilled the inclusion criteria were randomly selected for the study. Active mucosal COM was characterised by ear discharge and perforation of pars tensa.

Inclusion Criteria

Patients with active mucosal COM without complications.
Patients with COM not on any antibiotics for the past one week.

Exclusion Criteria

Patients who were already on systemic or topical antibiotics
Immunocompromised patients
Patients with active squamous epithelial COM
Any associated intracranial or intratemporal complications
Ear discharge following trauma or surgery to ear
Patients with external otitis

Patient's name, age and gender were documented along with a detailed history of present symptoms and past medical illness. The duration and type of ear discharge, any associated symptoms and the antibiotics taken, if any were recorded. History of any systemic illness like diabetes, ear surgery or trauma to the ear were noted. This was followed by a detailed general and otolaryngology examination. All the patients selected for the study had only unilateral ear discharge.

The ear swabs were collected under strict aseptic precautions. The debris and discharge present at the outer part of the external auditory canal was cleaned by suction clearance or mopping. This was to eliminate the presence of surface contaminants in the sample. A sterile ear speculum was used to inspect the canal and then the discharge from the deep external auditory canal was collected using a sterile cotton swab. The specimen was labelled and then transported to the microbiology department. In the lab the samples were plated on blood agar, chocolate agar and MacConkey agar. Alongside a smear was prepared for gram staining. The agar plates were incubated at 37° Celsius. After 24 hours the bacterial growth on the different growth plates were observed. These colonies were again gram stained to see whether it was a gram positive or gram-negative organism, cocci / bacilli or coccobacillary form. The bacteria were identified by different biochemical tests. The antibiotic sensitivity was done by Kirby-Bauer method.

Statistical Analysis

The patients' data including relevant history, examination findings, ear swab culture and sensitivity reports were recorded systematically. The data analysis was carried out

using Google Sheets and IBM SPSS Version 27. A p-value less than 0.05 was considered statistically significant.

RESULTS

Fifty patients with active mucosal COM were randomly selected for this study. There were 19 males (38 %) and 31 females (62 %) (Figure 1). There was no significant association between the gender and type of bacterial growth (Chi-square value 5.393 and p-value > 0.05).

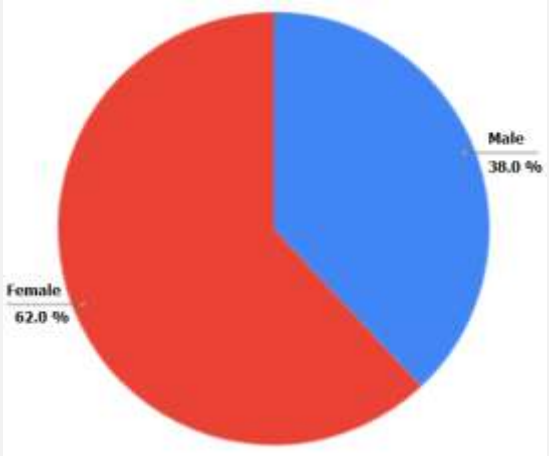

Figure 1. Gender Distribution of Patients

In our study the youngest was a 3 year old boy and the oldest was a 60 year old female. The mean age was 33 years. Standard deviation was 16.39. Majority of the patients (42 %) were in the age group of 21 - 40 years (Figure 2). There was no significant association between age and type of bacterial isolate (p-value > 0.05).

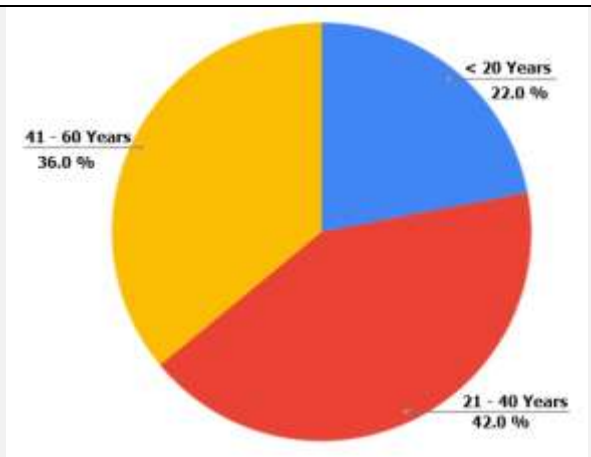

Figure 2. Age Distribution of Patients

All patients had a history of recurrent ear discharge. The discharge was mucopurulent, non-foul smelling and not bloodstained. For the majority of patients, the discharge started either following upper respiratory infection (60 %), self-cleaning the ear (18 %), or entry of water to ear during swimming or bathing (10 %). In 12 % of patients, no specific reason was identified. Twenty patients (40 %) had a history of hearing loss and 6 patients (12 %) had tinnitus. None of the patients had otalgia, headache, fever, swelling in or behind the ear or any other symptoms suggestive of complicated COM. On otoscopic examination there was perforation in the pars tensa of tympanic membrane for all patients (100 %). Ear swab culture studies showed bacterial growth in 44 samples (88 %). The bacterial isolates from the ear discharge included both gram-positive and gram-negative organisms. Two cases (4 %) showed fungal growth. Four samples (8 %) showed no growth even after 48 hours of incubation. Single bacterium was isolated in 41 cases (82 %) whereas 3 samples (6 %) showed more than one bacterial growth (Table 1).

Bacterial Isolate	Number	Percentage
Monomicrobial	41	82
Polymicrobial	3	6
Fungus	2	4
No growth	4	8

Table 1. Ear Swab Culture Results

The predominant bacteria were *Pseudomonas aeruginosa* (50 %) followed by *Staphylococcus aureus*. The other isolated pathogens were coagulase negative staphylococci, enterococci, enterobacter, acinetobacter and *E coli*. There was no association between age and monomicrobial or polymicrobial growth (p value > 0.05). Two samples showed growth of candida species.

Isolated Pathogens	Number	Percentage
Pseudomonas aeruginosa	23	50
Staphylococcus aureus	14	30.43
E. coli + *Staphylococcus aureus*	2	4.35
Enterobacter + Coagulase negative Staphylococcus	1	2.17
Acinetobacter	1	2.17
Enterobacter	2	2.17
Enterococci	2	4.35
Candida		4.35
Total Samples with Pathogens	**46**	**100**

Table 2. Isolated Pathogens

All the samples with *Pseudomonas aeruginosa* were sensitive to amikacin, piperacillin / tazobactam and imipenem (100 %). These isolates showed 91 % sensitivity to gentamicin and ciprofloxacin, and 86.9 % sensitivity to ceftazidime. *Staphylococcus aureus* showed maximum sensitivity to vancomycin and linezolid. They showed 93.7 % sensitivity to ciprofloxacin and gentamicin. Majority of the staphylococcus were resistant to erythromycin and ampicillin. All enterobacter cultures were sensitive to amikacin and gentamicin while they were resistant to other drugs tested. Enterococci isolates showed resistance to penicillin. *E. coli* were resistant to ampicillin (50 %) and cefuroxime, while they were sensitive to other drugs tested. Acinetobacter isolate showed sensitivity to amikacin, imipenem, gentamicin, ciprofloxacin, cotrimoxazole, and cefoperazone / sulbactam. Proper antibiotic was given to the patient after getting the culture and sensitivity reports. 21 patients with pseudomonas growth were treated with ciprofloxacin, and one child was given parenteral gentamicin. Two patients with pseudomonas growth which was resistant to ciprofloxacin and gentamicin were given inj. piperacillin / tazobactam. Patients with staphylococcus growth were treated with either oral ciprofloxacin or injection gentamicin. Patients showed good responses to therapy within 3 - 5 days. They were instructed to avoid

Bacteria	Total	GEN	CIP	IPM	PIT	AK	CAZ	VA	P	AMP	LZ	E
Pseudomonas aeruginosa	23 (100 %)	21 (91.3 %)	21 (91.3 %)	23 (100 %)	23 (100 %)	23 (100 %)	20 (86.96 %)	-	-	-	-	-
Staphylococcus aureus	16 (100 %)	15 (93.75 %)	15 (93.75 %)	-	-	-	-	16 (100 %)	-	4 (25 %)	16 (100 %)	9 (56 %)
Enterobacter	2 (100 %)	2 (100 %)	0 (0 %)	-	-	2 (100 %)	-	-	-	-	-	-
Enterococci	2 (100 %)	2 (100 %)	-	-	-	-	-	-	0 (0 %)	1 (50 %)	2 (100 %)	0 (0 %)
E-Coli	2 (100 %)	2 (100 %)	2 (100 %)	-	-	2 (100 %)	-	-	-	1 (50 %)	-	-
Coagulase negative staphylococcus	1 (100 %)	1 (100 %)	-	-	-	1 (100 %)	-	1 (100 %)	0 (0 %)	-	-	0 (0 %)
Acinetobacter	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	1 (100 %)	-	-	-	-	-	-

Table 3. Antibiotic Sensitivity Pattern of Isolated Bacteria

GEN : Gentamicin, CIP : Ciprofloxacin, IMP : Imipenem, PIT : Piperacillin / Tazobactam, AK : Amikacin, CAZ : Ceftazidime, VA : Vancomycin, P : Penicillin, AMP : Ampicillin, LZ : Linezolid, E : Erythromycin, - : Not tested.

using ear buds, use ear plugs while swimming and bathing, and to treat upper respiratory infection early to prevent recurrent ear discharge. In our study none of the patients developed complications of COM.

DISCUSSION

Chronic otitis media is a common infection in children and adults. In a study by Prakash R et al. the peak incidence of chronic suppurative otitis media was reported in individuals below 20 years.[2] In our study, majority of the patients were in the age group of 20 - 40 years. We included only patients above 3 years in our study. Both aerobes, anaerobes and fungi were isolated from the ear discharge in chronic suppurative otitis media patients.[2] Some common bacterial isolates in chronic suppurative otitis media include *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Haemophilus influenzae*, klebsiella and proteus species.[3,5,6,7] Our study included patients with active mucosal type of COM. The major bacteria isolated in our study was *Pseudomonas aeruginosa* followed by *Staphylococcus aureus*. This result is comparable with the majority of studies conducted earlier.[3,5,6,8,9,10,11,12,13]

Pseudomonas live better in moist environment. It has more predilection for sites of the body with cellular injury compared to normal tissues. So, the incidence of pseudomonas infection is more in patients with COM. Similar to our study, the percentage of other pathogens isolated were less in other studies too.[12] In some studies *Staphylococcus aureus* was the most common organism followed by pseudomonas.[2, 7,14,15] There was no significant difference in the bacterial flora isolated from both ears in the patients with bilateral ear discharge.[16] In our samples, single bacterial isolate was more as compared to polymicrobial growth. This result is similar to some previous research studies.[17,18,19] Polymicrobial aetiology is associated with more rapid deterioration of symptoms.[1] In the present study all patients showed symptomatic improvement in 3 - 5 days after starting proper antibiotics. Ear discharge completely subsided in 7 - 10 days. None of the patients developed complications.

In our study, the most effective antibiotics for pseudomonas were amikacin, piperacillin / tazobactam and imipenem. This is in correlation with the study conducted by Sattar et al.[8] In their study, *Pseudomonas aeruginosa* showed 100 % sensitivity to piperacillin / tazobactam and 98 % isolates were sensitive to imipenem. In some studies, ciprofloxacin was found to be almost 100 % effective for pseudomonas,[9] whereas in another study pseudomonas showed maximum sensitivity to amikacin followed by ceftazidime and ciprofloxacin.[3] In a study by Nwabuisi et al., ofloxacin was found to be 100 % effective for both gram positive and gram-negative organisms.[20] In our study, staphylococcus showed maximum sensitivity to vancomycin and linezolid. This is in correlation with some other studies.[21,22] The isolated pathogens showed varying degrees of resistance to the commonly used drugs like ampicillin, ceftazidime etc. In a study by Molla R et al. the most common pathogen in chronic suppurative otitis media was *Proteus mirabilis* which showed 100 % sensitivity to norfloxacin and ciprofloxacin.[23] In another study, all the aerobic isolates showed maximum sensitivity to amikacin, ceftriaxone and gentamicin.[2] Polymicrobial aetiology with different antibiotic sensitivity patterns necessitate the use of multidrug therapy in COM patients. In our study, candida was isolated in 4 % samples. Fungal growth in ear discharges was reported in few other studies.[2,8,13] The most common fungi in chronic suppurative otitis media was candida species and aspergillus species [2,13]

Review of literature showed that the bacterial isolates and their sensitivity pattern in COM are different in studies from different parts of the world. We conducted this study to isolate the pathogens prevalent in our population. The limitation of our study is small sample size as we included only patients with active mucosal disease.

CONCLUSIONS

Chronic otitis media was a common disease seen in all age groups and both genders. Both gram positive and gram-negative organisms were isolated from ear discharge in patients with active mucosal COM. Pseudomonas was the most common pathogen followed by *Staphylococcus aureus*. The most effective antibiotics for pseudomonas were amikacin, imipenem and piperacillin / tazobactam. *Staphylococcus aureus* showed maximum sensitivity to vancomycin and linezolid. It is better to take ear swabs for all patients at the first hospital visit itself to administer

proper antibiotics at the earliest to prevent complications of COM and antibiotic resistance.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.
Authors acknowledge Pramod Varughese Mathew, Assistant Professor, Department of Microbiology, SUT Academy of Medical Sciences.

REFERENCES

[1] Gleeson M, Clarke R. Scott-Brown's Otorhinolaryngology: head and neck surgery. 7th edn. London: CRC Press 2008.
[2] Prakash R, Juyal D, Negi V, et al. Microbiology of chronic suppurative otitis media in a tertiary care setup of Uttarakhand state, India. N Am J Med Sci 2013;5(4):282-287.
[3] Mansoor T, Musani MA, Khalid G, et al. *Pseudomonas aeruginosa* in chronic suppurative otitis media: sensitivity spectrum against various antibiotics in Karachi. J Ayub Med Coll Abbottabad 2009;21(2):120-123.
[4] Loy AHC, Tan AL, Lu PKS. Microbiology of chronic suppurative otitis media in Singapore. Singapore Med J 2002;43(6):296-299.
[5] Kumar H, Seth S. Bacterial and fungal study of 100 cases of chronic suppurative otitis media. J Clin Diagn Res 2011;5(6):1224-1227.
[6] Poorey VK, Lyer A. Study of bacterial flora in csom and its clinical significance. Indian J Otolaryngol Head Neck Surg 2002;54(2):91-95.
[7] Shresta BL, Amatya RCM, Shresta I, et al. Microbiological profile of chronic suppurative otitis media. Nepal J ENT Head Neck Surg 2011;2(2):6-7.
[8] Sattar A, Alamgir A, Hussain Z, et al. Bacterial spectrum and their sensitivity pattern in patients of chronic suppurative otitis media. J Coll Physicians Surg Pak 2012;22(2):128-129.
[9] Deb T, Ray D. A study of the bacteriological profile of chronic suppurative otitis media in Agartala. Indian J Otolaryngol Head Neck Surg 2012;64(4):326-329.
[10] Sharma K, Aggarwal A, Khurana PMS. Comparison of bacteriology in bilaterally discharging ears in chronic suppurative otitis media. Indian J Otolaryngol Head Neck Surg 2010;62(2):153-157.
[11] Madana J, Yolmo D, Kalaiarasi R, et al. Microbiological profile with antibiotic sensitivity pattern of cholesteatomatous chronic suppurative otitis media among children. Int J Pediatr Otorhinolaryngol 2011;75:1104-1108.
[12] Shetty AK, Shetty A. Aerobic bacteriological profile and their antibiotic susceptibility in chronic suppurative otitis media in patients from Mangalore, Karnataka State. J Acad Clin Microbiol 2014;16(1):3-7.
[13] Mohan U, Jindal N. Fungal and bacterial flora of chronic suppurative otitis media in Amritsar (Punjab). Indian J Otolaryngol Head Neck Surg 1998;50(2):175-177.
[14] Ahmad S. Antibiotics in chronic suppurative otitis media: a bacteriologic study. Egypt J Ear Nose Throat Allied Sci 2013;14(3):191-194.
[15] Prakash M, Lakshmi K, Anuradha S, et al. Bacteriological profile and their antibiotic susceptibility pattern of cases of chronic suppurative otitis media. Asian J Pharm Clin Res 2013;6(3):210-212.
[16] Orji FT, Dike BO. Observations on the current bacteriological profile of chronic suppurative otitis media in South Eastern Nigeria. Ann Med Health Sci Res 2015;5(2):124-128.
[17] Shyamla R, Reddy PS. The study of bacteriological agents of chronic suppurative otitis media-aerobic culture and evaluation. J Microbiol Biotechnol Res 2012;2:152-162.
[18] Aslam MA, Ahmed Z, Azim R. Microbiology and drug sensitivity patterns of chronic suppurative otitis media. J Coll Physicians Surg Pak 2004;14(8):459-461.
[19] Sharma S, Rehana HS, Goyal A, et al. Bacteriological profile in chronic suppurative otitis media in Eastern Nepal. Trop Doct 2004;34(2):102-104.
[20] Nwabuisi C, Ologe FE. Pathogenic agents of chronic suppurative otitis media in Ilorin, Nigeria. East Afr Med J 2002;79(4):202-205.
[21] Rangaiah ST, Dudda R, Prasad HM, et al. Bacteriological profile of chronic suppurative otitis media in a tertiary care hospital. International Journal of Otorhinolaryngology and Head and Neck Surgery 2017;3(3):601-605.
[22] Nazir A, Kadri SM. Aerobic bacteriology of chronic suppurative otitis media: a hospital-based study. International Journal of Research in Medical Sciences 2014;2(4):15-21.
[23] Molla R, Tiruneh M, Abebe W, et al. Bacterial profile and antimicrobial susceptibility patterns in chronic suppurative otitis media at the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia. BMC Res Notes 2019;12(1):414.